Palacký University Olomouc

Transactions on Transport Sciences
Peer-Reviewed Open Access Journal
Vol. 2/2025 DOI: 10.5507/tots.2025.013
journal homepage: www.tots.upol.cz

Studying Near–miss Accidents instead of Crashes: Psychometric Characteristics of Near–miss Traffic Accidents Scale in Lithuanian Sample

AUSTĖJA KILIUTĖ, GODA SKINKYTĖ, TADAS VADVILAVIČIUS

Vytautas Magnus university, Kaunas, Lithuania

ABSTRACT: **Purpose**. Road traffic accidents (RTA) still are a major problem that causes health problems or death. However, it is difficult to study RTA since relatively small amount of them happen. For this reason, researchers turn to near-miss traffic accidents as construct that can be related to RTAs. Though near-miss traffic accidents are included in research, evidence about reliability and validity of measurement instruments are still lacking. Due to that this study **aim** - to examine near-miss traffic accidents scale psychometric characteristics. **Method**. This research involved two different age (young and middle-aged drivers and older drivers) drivers' groups. Young and middle-aged drivers' group consisted of 114 participants (50 males; age M = 27.08; SD = 9.66). Older drivers' group contained 260 drivers (144 males; M = 68.44; SD = 6.92). Participants had to complete Near-miss traffic accidents scale (Kurita et al., 2023; Makizaco et al., 2018), Driver Behavior questionnaire (DBQ) (Parker et al., 1995), questions about sociodemographic aspects and experience of real traffic accidents. **Results**. This research showed that Near-miss traffic accidents scale was reliable in both drivers' groups. Confirmatory factor analysis suggested that scale has one factor and can be used to make valid comparisons between both drivers' groups. Results from older drivers' group confirmed that scale correlates with DBQ's errors and lapses subscales which shows scale's construct validity. However, results about scale relationship with age, gender and real traffic accidents experience are different in both drivers' groups. **Discussion**. While some results in this study confirm Near-miss traffic accidents reliability and validity, other results do not allow to do reasonable conclusions about this instrument psychometric characteristics. It is crucial to continue investigating this scale in order to understand if results differences showing in this research are due to instrument flaws or methodological aspects of this study.

KEYWORDS: Near-miss traffic accidents; errors and lapses; real traffic accidents; reliability; validity

1. INTRODUCTION

Road traffic accidents (RTA) are a major problem that can cause health problems or death. In 2021, based on WHO (2023) data, approximately 1,19 million people died in road traffic accidents worldwide. While in Lithuania, in the previous year, about 3,000 RTA occurred where nearly 200 people had died (Transporto kompetencijų agentūra, 2024). However, not all traffic accidents are being registered by the police, so it is likely that there are even more accidents than the official statistics indicate. High rates of RTA that can lead to health issues and possibly death show that it is still important to look at the factors that can contribute to road traffic accidents. It is prominent to highlight that road traffic accident statistics are obtained from officially recorded data, so it is reasonable to think that there are even more RTA in everyday life.

It is difficult to study real road traffic accidents themselves, since relatively few of them are recorded. So, when studying road safety, it is important to focus not only on RTA that have occurred, but also on near-miss accidents that happen on the road. The term near-miss is used in various contexts including work, medical situations, etc. Such a term is also used in traffic situations. Nevertheless, there is no mutually agreed near-miss definition, but literature suggests that near-miss traffic accidents could be defined as a situation in which the driver manages to make certain actions to avoid real collision that could cause harm (Balami & Sambo, 2019; Bekelcho et al., 2024; Powell et al., 2007). Such driver actions that prevented a collision include sudden braking or rapid steering operations (Balami & Sambo, 2019). This paper will follow the definition of near-miss traffic accidents given before.

In traffic psychology studies, several factors relationship with risky driving behaviour are being investigated. Typically, differences between age and gender are found, young and male drivers demonstrating more risky driving than older and female drivers (Rhodes & Pivik, 2011). However, studies show, that although men demonstrate more risky driving overall, women tend to make more driving mistakes (De Winter & Dodou, 2010). In near–miss studies in older drivers' sample, different result about age and gender are found (Kurita et al., 2023; Kurita et al., 2024; Makizaco et al., 2018). Some studies (Kurita et al., 2023; Kurita et al., 2024) show that age is significant factor in the occurrence of near–miss traffic accidents, while other studies (Makizaco et al., 2018) reported no significant relationship between age and near–miss traffic accidents. In addition, authors (Kurita et al., 2023; Kurita et al., 2024) note that gender is significant predictor of near–miss traffic accidents, men being more likely to experience a near–miss while driving. Although results in older drivers' sample indicate, that male gender is significant predictor (Kurita et al., 2023; Kurita et al., 2024), other literature about driving errors show opposite results (De Winter & Dodou, 2010). These differences can be due to different instruments and different statistical procedures. Nevertheless, based on wider base of literature, it can be expected, that younger and female drivers would experience more mistakes on the road.

While reading existing literature, only a small number of researchers include near-miss traffic accidents in their analysis (Balami & Sambo, 2019; Bekelcho et al., 2024; Kurita et al., 2023; Kurita et al., 2024; Powell et al., 2007) and there is no single questionnaire that is being used in studies. Even though there is no single questionnaire, researchers make up

their own set of questions and include them in their studies about near-miss traffic accidents because they might reflect unsafe driving behaviour and foresee actual car accidents. What is more, authors notice that there is a need to analyse the relationship between near-miss traffic accidents and actual RTAs (Bakelcho et al., 2024) hoping that near-miss traffic accidents could have a prognostic value to real traffic accidents and can be used in traffic studies as important variable. Since near-miss traffic accidents are being investigated, it is important to have a reliable and valid measuring instrument.

Makizaco et al. (2018) and Kurita et al. (2023) provide a set of questions that can be used as a method to measure experiences of near-miss traffic accidents. In this set of questions participants have to choose whether they experienced given near-miss situation or not. In statistical analysis, authors divide respondents into two groups: either respondents have experienced one or more near-miss accident or have not, but do not provide reasons for this decision. Respondents' answers categorisation into two groups might not reveal the full picture, because it is important not only to know the fact that the driver experienced a near-miss traffic accident but also investigate in how many traffic situations a near-miss traffic accident occurred. Opposing to accidental error, variance in near-miss traffic accidents quantity might show a distracted driving pattern.

What is more, the questions about near-miss traffic accidents include quite various situations that might have been experienced by respondents in a 12-month period. This period is relatively long, so the number of respondents with no such experience is likely to be small, which might lead to inaccurate data. Therefore, it might be useful to use this set of questions as a scale and calculate the total score of these questions, i.e. in how many different situations a person has experienced a near-miss traffic accident. Due to the reason that it might reveal a deeper insight into near-miss experiences and real RTAs. These given reasons encouraged to do research examining whether questions about near-miss traffic accidents can be used as a one factor structure scale. So, the **aim** of this research - to examine near-miss traffic accidents scale psychometric characteristics.

2. METHOD

2.1 Participants

There were two groups of participants (young and middle-aged drivers' group and older drivers' group) that formed a sample, which data was used in different stages of result analysis. For participants gathering convenience sampling technique was used. Both groups sociodemographic characteristics can be seen in Table 1.

First group was formed from young and middle-aged drivers. a total of 114 respondents participated in this study. Their age ranged from 19 to 53. Most participants were young (43.0% of participants are 21-30 years old). Respondents' driving experience varied from 4 months to 30 years (M = 7.71; SD = 8.30). It is important to note that a major part of participants (33.3%) had less than 2 years of driving experience. There were two main inclusion criteria of the respondents. First, respondents had to have a valid driving licence and second, respondents had to drive a vehicle at least once a month. Those who did not met these criteria were excluded from the sample.

Second group was from older drivers. A total of 260 participants agreed to be a part of the study voluntarily. Respondents' age varied from 60 to 97 years. Their driving experience ranged from 3 to 68 years (M = 40.03, SD = 11.79). Although only one participant (0.4%) had less than 10 years of driving experience. For respondents to be included in the research there were three main inclusion criteria. To start with, participant had to be at least 60 years old. Secondly, to have a valid driving licence, and thirdly, they had to drive a vehicle at least once a month.

2.2 Measures

2.2.1 Demographic questions

Information about participants sociodemographic characteristics, such as age and gender, was gathered. Also, participants were asked about aspects, related to their driving experience, e.g. type of driving licence, driving experience in years.

2.2.2 Experiences of near-miss traffic accidents

Experiences of near-miss traffic accidents, that were drivers' fault, were assessed using 13 questions about situations while driving in the previous 12 months. The participants were asked to choose between "yes" or "no" answering about those 13 experiences, e.g. "*When going from a stop line, I almost hit someone coming from a different direction*". Original questions about 12 situations were used in study about traffic incidents among older drivers (Makizaco et al., 2018; Kurita et al., 2023). For this study, one situation (*"When starting on a hill, I almost hit another vehicle or obstacle (including living things)"*) was separated into two (*"When starting on a hill, I almost hit another vehicle or obstacle (including living things)", "When starting on a hill I rolled backwards and almost hit another vehicle or obstacle (including living things)"*) due to belief that it is more accurate to assess two different situations instead of one. Also, one question was modified by removing the words "parking lot", as the researchers felt that this definition of location unreasonably limits the number of traffic situations that participant can assess. Each positive answer to a question was scored one point. Then total score was added together. The higher the score, the more different near-miss traffic accidents participant experienced in the past 12 months.

2.2.3 Driver behavior questionnaire (DBQ)

The 24-item Lithuanian version of DBQ (Parker et al., 1995; Stelmokienė et al., 2013) was used to measure self-reported aberrant driving behaviour among older drivers' group. In this research 8-item errors and 8-item lapses subscales were used. Participants were asked to indicate how often they engage in provided situations regarding errors (e.g. *"Not noticing pedestrians crossing"*) and lapses (*"Forget where the car is in a car park"*) on 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Higher score indicates higher propensity to drive in aberrant way. This scale has been used in Lithuanian population numerous times and both subscales

Participants group (number of participants)	Gender		Age	Use of the data
	Men	Women		
Young and middle-aged drivers' group (114)	50	64	M = 27.08 SD = 9.66	Reliability analysis, content validity: factor analysis, construct validity (gender and age), criterion validity
Older drivers' group (260)	144	116	M = 68.44 SD = 6.92	Reliability analysis, content validity: factor analysis, construct validity (gender, age and DBQ), criterion validity

Table 1. Sociodemographic characteristics of the sample.

demonstrated good internal consistency in different samples, ranging from .71 to .89 (Stelmokienė et al., 2013). In this research errors and lapses subscales internal consistency was respectively .70 and .68, which indicated that both subscales can be used in research.

2.2.4 Car collisions

As the primary outcome, the experience of car collisions was assessed using the following interview questions: *"Have you been involved in a car accident when you were at fault during the past 12 months?"* and *"Have you been involved in a car accident when someone else was at fault during the past 12 months?".* Participants were asked to choose an answer: 1 (no, I haven't), 2 (yes, 1 time), 3 (yes, a few times) or 4 (yes, more than 5 times).

2.3 Procedure

There were two different procedures for both participants groups. For young and middle-aged drivers' group the study was advertised on social media platform "Facebook" via posts. People were invited to participate in this study voluntarily. All participants completed informed consent and self-reported questionnaire at the webpage. No reward was offered for participation.

Older drivers were gathered to participate in ongoing project called "Maintaining safe driving competence in older drivers" carried by a group of psychology researchers led by PhD Laura Šeibokaitė. For older drivers the selection of the study sample was conducted in several different ways. Firstly, a research agency identified potential participants who met the selection criteria. Upon consent, their contact information was shared with the researchers, who then coordinated the details of their participation. Additionally, organizations representing older adults, e. g. the Lithuanian Association of the Elderly, were approached. The invite included contact details for scheduling participation. What is more, the invitation was shared via personal social media platforms (e. g., Facebook, LinkedIn). University staff were invited via email. All participants signed the informed consent and completed the questionnaires during in-person meetings with the researchers or project specialists. As compensation for their time, participants were given a 10€ gas station gift card. Ethical approval for the research was obtained from Ethics Committee of Psychology at the Department of Psychology at Vytautas Magnus University in Lithuania.

2.4 Statistical analysis

Data were analysed using Statistical Package for the Social Sciences (SPSS) version 29.0, R (R Core Team, 2024), RStudio (RStudio Team, 2024), and the lavaan (v. 0.6-16, Rosseel, 2012) package. Both participants groups data distribution was not near normal, therefore nonparametric statistics were used. Spearman Rho criteria was used to determine zero-order correlations between experience of near-miss traffic accidents and age, DBQ errors and lapses subscales, experience of RTAs. Also, Mann-Whitney U criteria was used for comparing near-miss traffic experiences between gender.

3. RESULTS

3.1 Reliability Analysis

For reliability confirmation, internal consistency criteria was used. In the young and middle-aged drivers' group Cronbach alpha was = .73 and in the older drivers' group = .65. In young and middle-aged drivers' group Cronbach alpha is bigger. However, internal consistency in different groups does not significantly differ from each other (Chi-square (df = 1) - 2.17, p = .139). Formula for coefficients comparison is (Diedenhofen & Much, 2016):

$$UX_{dep} = \sum_{i=1}^{m} \frac{\left((1 - \xi_i)^{-\frac{1}{3}} - \bar{\mu}\right)^2}{(S^2 - \bar{C})}$$

As it can be seen, internal consistency varies between groups from fairly good to good with scale questions being more consistent with each other in young and middle-aged drivers' group. Nevertheless, results indicate that scale can be used in research, due to its internal consistency being above .60 (Ponterotto & Ruckdeschel, 2007).

3.2 Content validity: factor analysis

In order to confirm factorial structure in both groups of drivers, confirmatory factor analysis was done. In the young and middle-aged drivers' group results revealed that the model fits the data adequately (Chi-square (df=65) - 114.97, p < .001, CFI = .94, TLI = .92, RMSEA = .08 (95%CI [.06; .11]). Also, in the older drivers' group results revealed that the model fits the data well (Chi-square (df=65) - 82.21, p = .07, CFI = .97, TLI = .97, RMSEA = .03 (95%CI [.00; .05]). These results show that this scale is appropriate to use in both groups. Although, it is more suited to be used in older drivers' group.

To test if the scale is suitable in multiple groups, invariance analysis was performed. Table 2 presents results of the multi-group confirmatory factor analysis for the structure of the instrument.

Model	χ^2	df	p	CFI	TLI	RMSEA
Configural invariance	211.94	130	< .001	.94	.93	.06
Metric invariance	271.14	142	< .001	.91	.90	.07
Scalar invariance	230.67	141	< .001	.94	.93	.06

Note. TLI - Tucker Lewis index; CFI - comparative fit index; RMSEA - root mean square error of approximation.

Table 2. Model invariance analysis.

Good configural variance suggested that the factor structure was equivalent across both tested samples of older and young and middle-aged drivers; good metric invariance indicates that the items in the scale were interpreted similarly by different groups of drivers, suggesting no systematic bias in responses; and good scalar invariance supports the conclusion that the scale effectively measures near-miss in both drivers` groups, meaning that while differences between groups can be found, these are likely to genuine group differences rather than flaws in the measurement instrument (Putnick et al., 2016). In general, results confirmed that scale was reliable and could be used to make valid comparisons between drivers' groups.

3.3 Construct validity

To verify scale construct validity several analyses were carried out. To see if near-miss traffic accidents scale measures what it supposes to measure, age, gender and DBQ errors and lapses subscales had been chosen as variables. Near-miss traffic accidents' relationship with age and differences between gender were measured in both groups, while scale relationship with errors and lapses subscales were measured only in older drivers' group.

3.3.1 Near-miss traffic accidents relationship with age

For near-miss traffic accidents relationship with age analysis Spearman Rho criteria was used. In young and middle-aged drivers' group significant moderate negative correlation was found (*rho* = -.33, *p* < .001). Meaning involvement in near-miss traffic accidents decreases with increasing age. In older drivers' group no significant result was found (*rho* = -.01, *p* = .819).

3.3.2 Near-miss traffic accidents between gender

For differences between gender analysis Mann-Whitney U criteria was used. Results are presented in Table 3.

Experience of near-miss traffic accidents between groups	Mean ranks		Mann-Whitney U	Z	*p*
	Men	Women			
Young and middle-aged drivers' group	48.34	64.66	1142.00	-2.67	.007
Older drivers' group	126.22	130.20	7786.00	-.45	.653

Table 3. Experience of near-miss traffic accidents between groups.

In young and middle-aged drivers' group there were significant differences between men and women involvement in near-miss traffic accidents, women being involved in more near-miss traffic accidents that men. On the other hand, there was no significant differences between genders in older drivers' group.

3.3.3 Near-miss traffic accidents relationship with DBQ errors and lapses subscales

Finally, relationship between near-miss traffic accidents and two DBQ scales measuring driving errors and lapses were analysed. For this analysis Spearman Rho criteria were used. Results showed that near-miss traffic accidents have correlation with both errors (rho = .51, p < .001) and lapses (rho = .41, p < .001) subscales. Such finding indicates that near-miss traffic accidents scale has good construct validity, due to the similarity with subscales that also measures drivers' mistakes on the road.

3.4 Criterion validity

To confirm criterion validity real traffic accidents were used as criteria. It was expected that being involved in RTA would be associated with near-miss traffic accidents in both young and middle-aged and older drivers' groups. For this analysis Spearman Rho correlation coefficient was used. Results are presented in Table 4.

Near-miss traffic accidents experience between groups	RTA was driver's fault		RTA was another driver's fault	
	rho	*p*	*rho*	*p*
Young and middle-aged drivers' group	.28	.003	.02	.843
Older drivers' group	.09	.144	.13	.041

Table 4. Near-miss traffic accidents experience between groups.

Results in different drivers' groups differ from each other. In young and middle-aged drivers' group significant relationship was found only between near-miss traffic accidents experiences and RTA that was drivers' fault. However, in older drivers' group results were completely opposite.

4. DISCUSSION

This study was conducted to investigate whether set of questions about near-miss traffic experiences can be used as a scale. For this reason, psychometric characteristics: reliability and validity were assessed in two different age drivers' groups. Statistical analyses show that near-miss traffic accidents scale has good internal consistency in both young and middle-aged and older drivers' groups, Cronbach alpha respectively being .73 and .65. This reveals that scale is reliable and can be used in different age drivers' groups.

Confirmatory factor analysis confirmed one factor structure. In addition, good scalar invariance supports conclusion that scale can be used for near-miss traffic accidents measuring in different age drivers' groups. In general, statistical results show that scale not only can be used in different age drivers' groups but also can be used for making valid comparison between given groups.

Regarding the construct validity of the scale, results confirm a moderate correlation between DBQ errors and lapses subscales. This result show that near-miss traffic accidents scale measures mistakes while driving. This finding is important in further scale validation. Due to assumption that near-miss traffic accidents scale measures construct similar to DBQ's errors and lapses, similar results to those existing in literature about drivers errors and lapses can be expected in different drivers' groups.

While results about scale internal consistency and factorial structure are quite similar in young and middle-aged and older drivers' groups, results about near-miss traffic accidents relationship with age, RTA's and gender are different. Young and middle-aged drivers' group result support existing literature that younger drivers tend to drive in more aberrant manner than the older drivers (Rhodes & Pivik, 2011). However, it is possible that the lack of correlation between age and near-miss traffic accidents in the older drivers' group may be due to the fact the drivers in this group are relatively similar in age and that there is simply not enough variation in age to detect correlation. In addition, no relationship between near-miss traffic accidents and age can be explained using findings which show that similar phenomena of DBQ errors and lapses have no significant change over time in older drivers' group (Koppel et al., 2018).

When talking about inconsistencies between results about gender differences between groups, a few points can be made. Firstly, results in young and middle-aged drivers' group support results existing in literature that women tend to do more errors than men (De Winter & Dodou, 2010), but men demonstrate more risky driving overall (Rhodes & Pivik, 2011). So, it can be thought that near-miss traffic accidents quite well reflect certain type of aberrant driving behaviour described in mistakes while driving. However, in older drivers' group results do not support such assumption. It can be contemplated that results between groups differ due to differences between groups rather than scale flaws. But we have to admit that we are currently unable to offer reasonable explanation for why it happened.

What is more, results in young and middle–aged drivers' group show that near-miss traffic accidents correlate with real traffic accidents experience when RTA was drivers' fault. Those findings align with literature about errors and lapses as predictors of real traffic accidents (De Winter & Dodou, 2010). Significant correlations between near-miss traffic accidents and other constructs related to mistakes on the road or overall risky driving can be understood as confirmation of scale validity. On the other hand, results in older drivers' group show that near–miss traffic accidents correlate with RTA, which was other drivers' fault. Nevertheless, the correlation is very weak, so it is possible that this relationship was found accidentally. Yet, to be able to draw conclusions about relationship between near–miss traffic accidents and RTA it is important to look further into these variables.

While results inconsistency about constructs that can be used to determined scale construct and criteria validity between groups can be due to differences in data collection, it also can be caused by personal differences, such as age and driving experience. Nevertheless, these inconsistencies are important for scale validation because differing results does not allow to do reasonable conclusions. That being said, this study provides some results that show scale reliability and validity, but inconsistent results between groups prevent from solid conclusions about Near-miss traffic accidents scale

psychometric characteristics. So, in order to better understand Near-miss traffic accidents scale psychometric characteristics, it is important to further investigate this scale within different samples.

5. LIMITATIONS

A limitation of this study might have been the difference in data collection methods between groups: older drivers completed the questionnaire face-to-face, while young and middle-aged drivers participated online. This discrepancy may have affected older drivers' responses. Considering the subject of the research, that was near-miss traffic accidents, older drivers might have adjusted their responses due to the presence of younger project specialists. This sense of being monitored could have influenced participants to underreport or modify their answers, compared to how they might have responded in a more private, online setting. It should also be noted that this study relied on self-report data, which may be influenced by social desirability or memory biases. Consequently, it is difficult to determine whether differences in responses are due to the scale characteristics or the varying difference of the research conditions. This limitation complicates direct comparisons between older drivers' and young and middle-aged drivers' groups. Additionally, it is important to note that young and middle-aged drivers were combined into a single group due to the relatively small sample sizes of these two groups when considered separately. This decision was made to increase statistical power and ensure more robust analyses. Future researchers might consider using this scale across different conditions, both online and face-to-face, to assess if the results can be replicated. This approach would help to determine whether the scale produces consistent results in various settings and if it effectively measures what it intends to, regardless of the mode of administration. Moreover, future studies could benefit from including a broader range of age groups to capture a more comprehensive understanding of near-miss experiences and to allow more detailed comparisons between two groups.

FUNDING

This research was funded by grant No. S-VIS-23-12 from the Research Council of Lithuania (LMTLT).

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